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Patents Form 1/77

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Request for grant of a patent

1.	Your Reference	PLB/CC/W152
2.	Application number	0204929.4 01 MAR 2002
3.	Full name, address and postcode of the or each Applicant Country/state of incorporation (if applicable)	**Per-Tec Limited** **Manchester School of Engineering** **The University of Manchester** **Simon Building** **Oxford Road** **Manchester M13 9PL** 8093106001 **Incorporated in: England & Wales**
4.	Title of the invention	**Improvements In and Relating to Gas Flow Arrangements**
5.	Name of agent Address for service in the UK to which all correspondence should be sent Patents ADP number	**APPLEYARD LEES** **15 CLARE ROAD** **HALIFAX** **HX1 2HY** **190001** ✓
6.	Priority claimed to:	Country / Application number / Date of filing
7.	Divisional status claimed from:	Number of parent application: - / Date of filing: -
8.	Is a statement of inventorship and of right to grant a patent required in support of this application?	**YES**

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Continuation sheets of this form	
Description	12 x 2 ✓
Claim(s)	cf
Abstract	
Drawing(s)	8 x 2 ✓

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Priority documents	
Translation of priority documents	
Statement of inventorship and right to grant a patent (PF 7/77)	
Request for a preliminary examination and search (PF 9/77)	
Request for substantive examination (PF 10/77)	
Any other documents (please specify)	

11. We request the grant of a patent on the basis of this application.

Signature: **APPLEYARD LEES**

Date: **28 February 2002**

Appleyard Lees

12. Contact **Paul Brandon – 0161 835 9655**

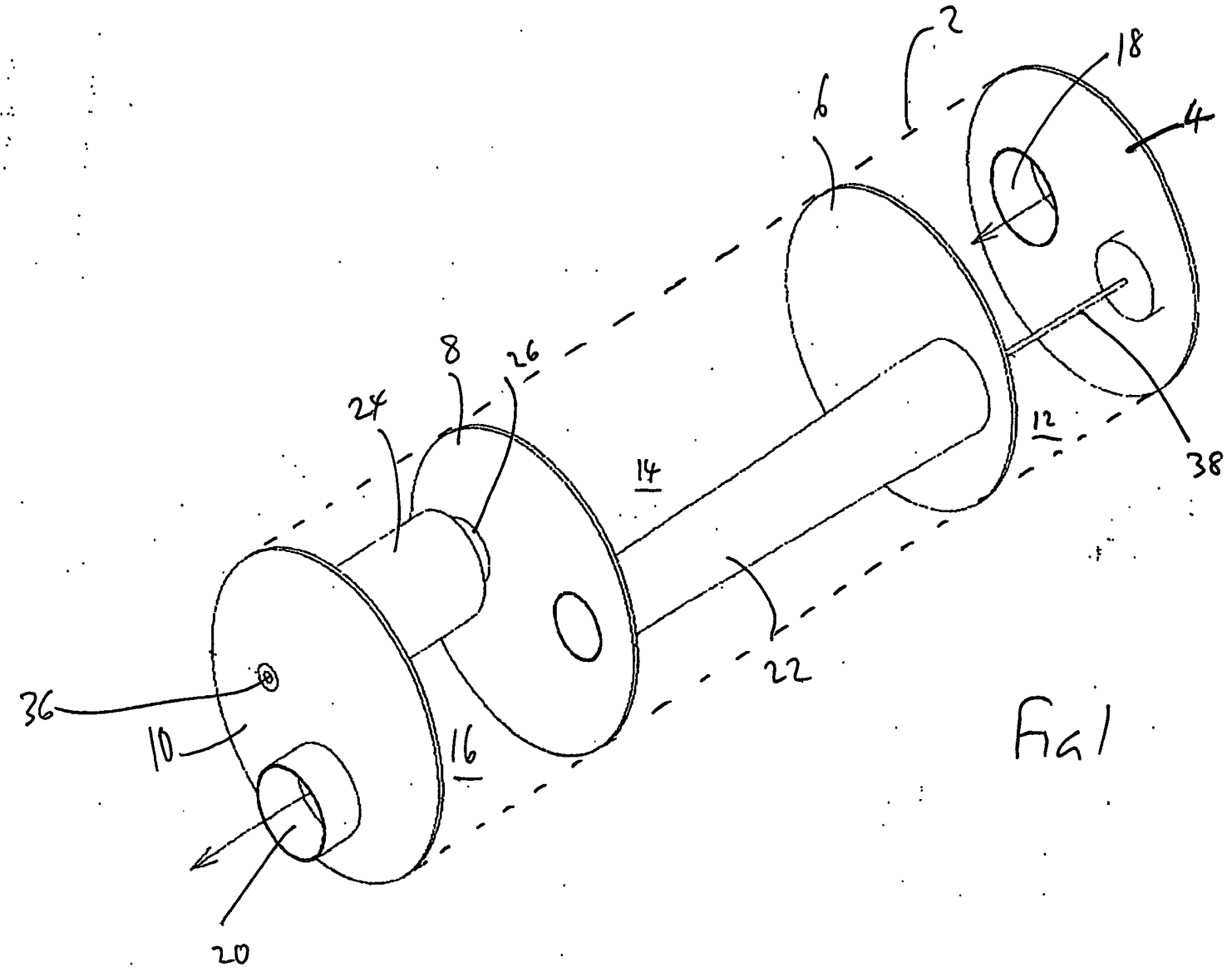


Fig 1

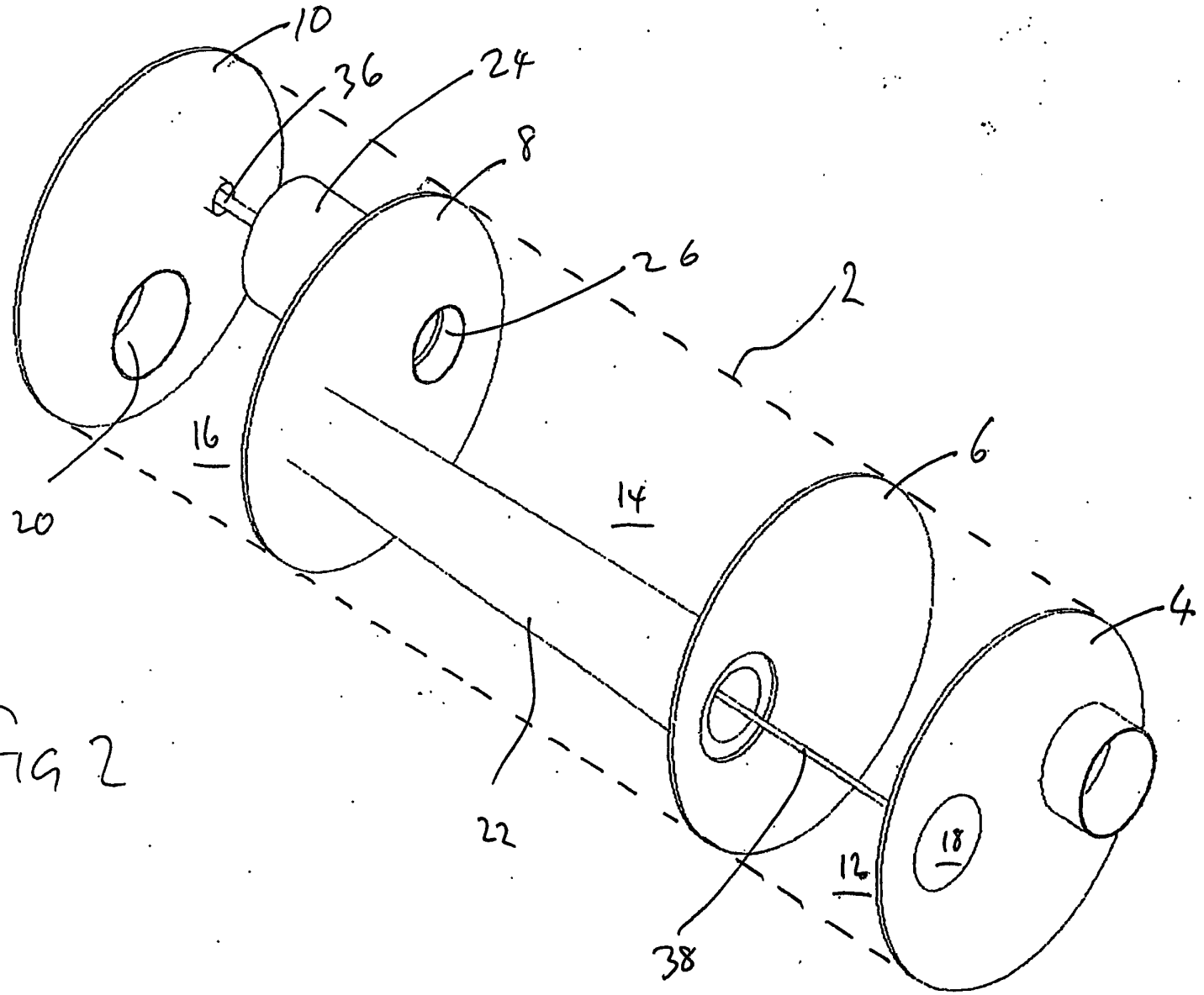


Fig 2

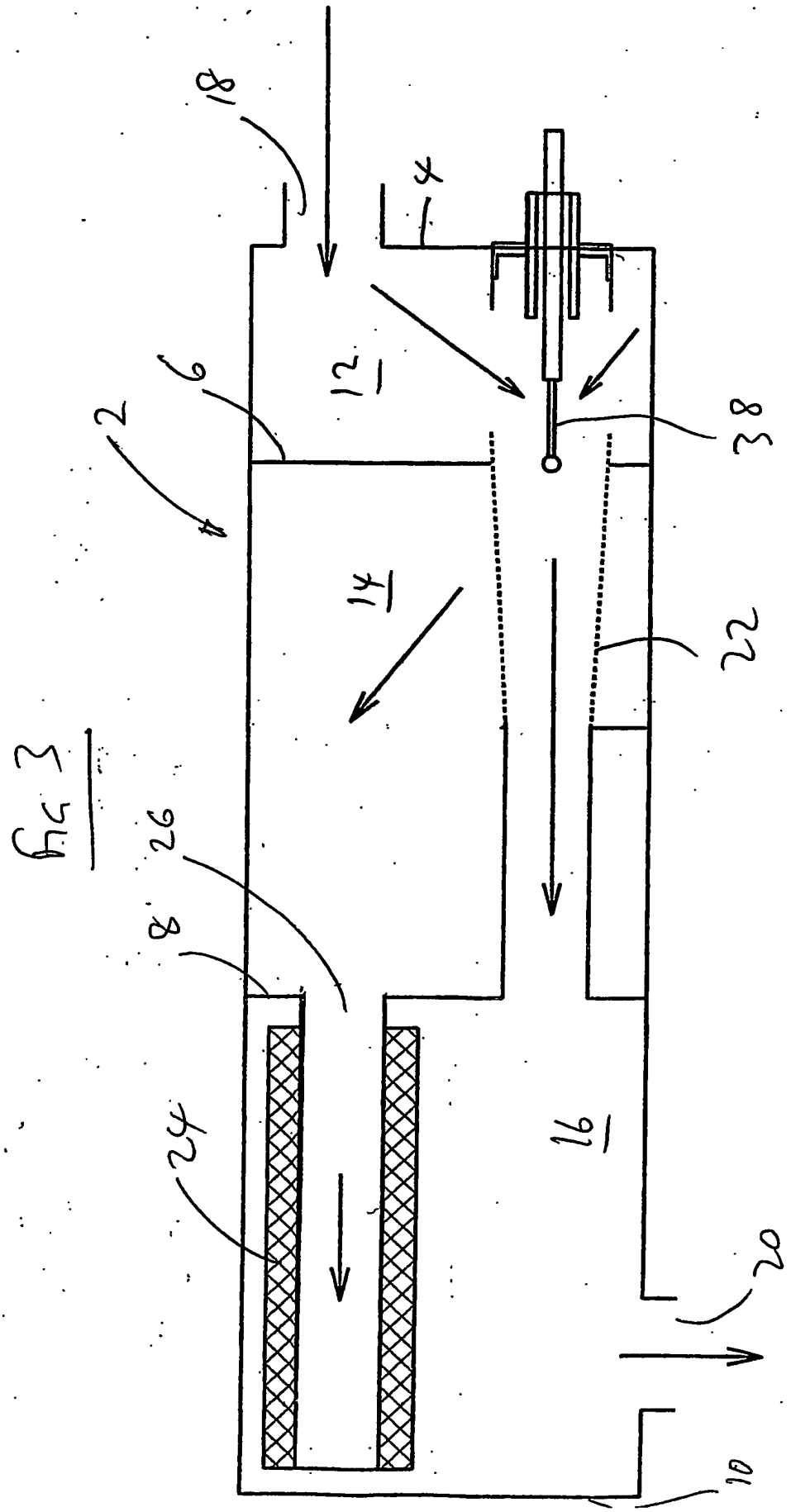


Fig 3

Fig 4

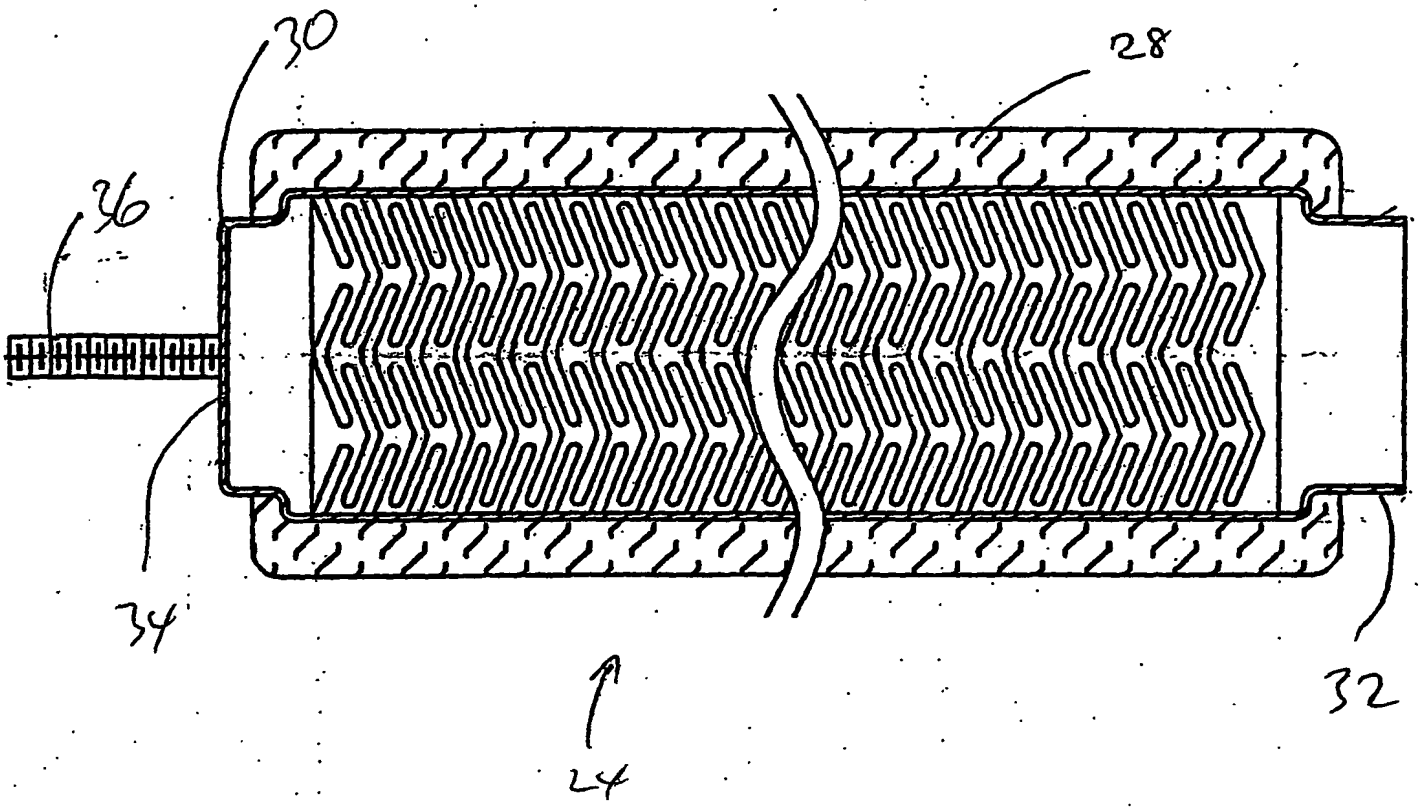


FIGURE 5

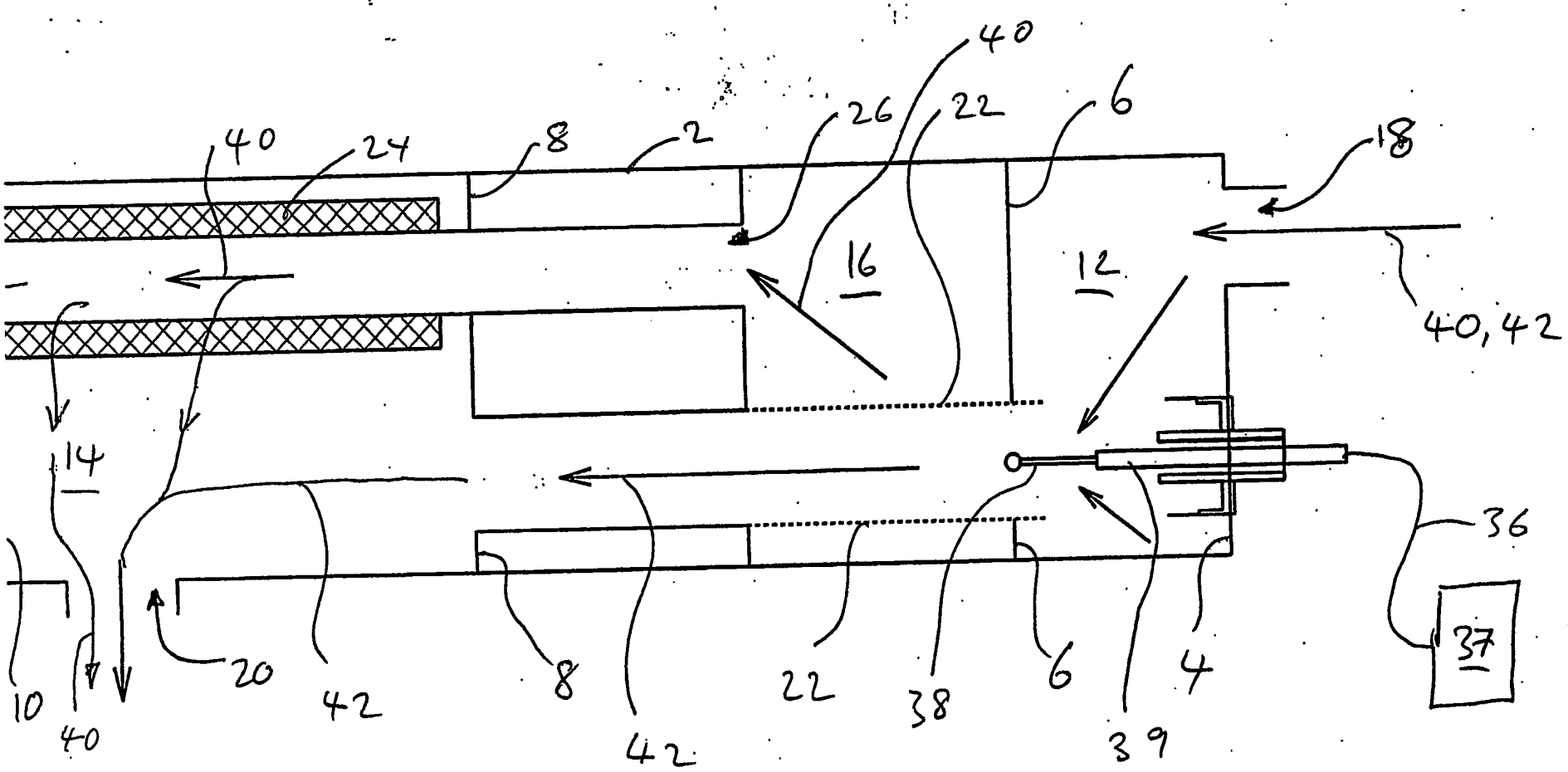


FIGURE 6

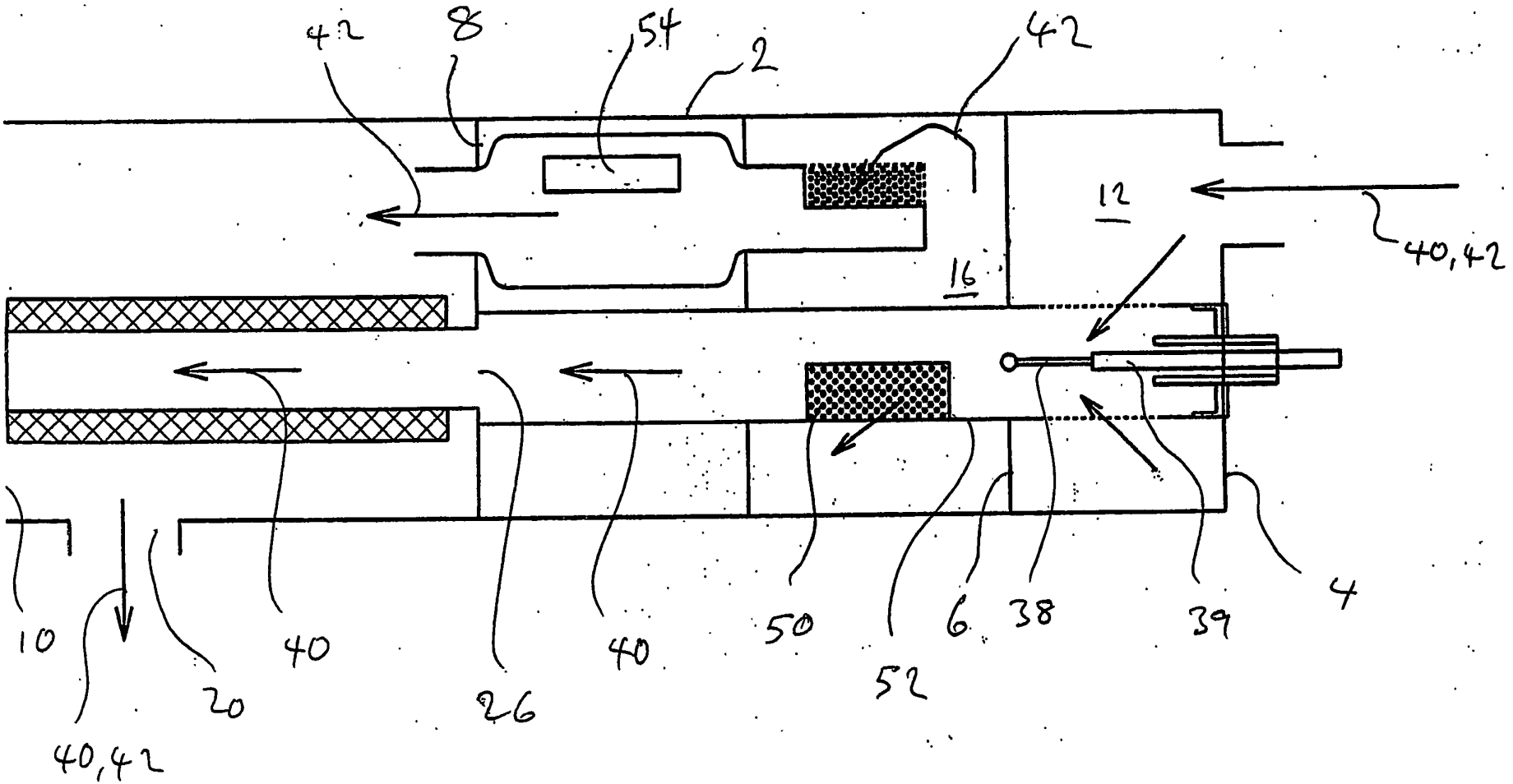


Figure 7

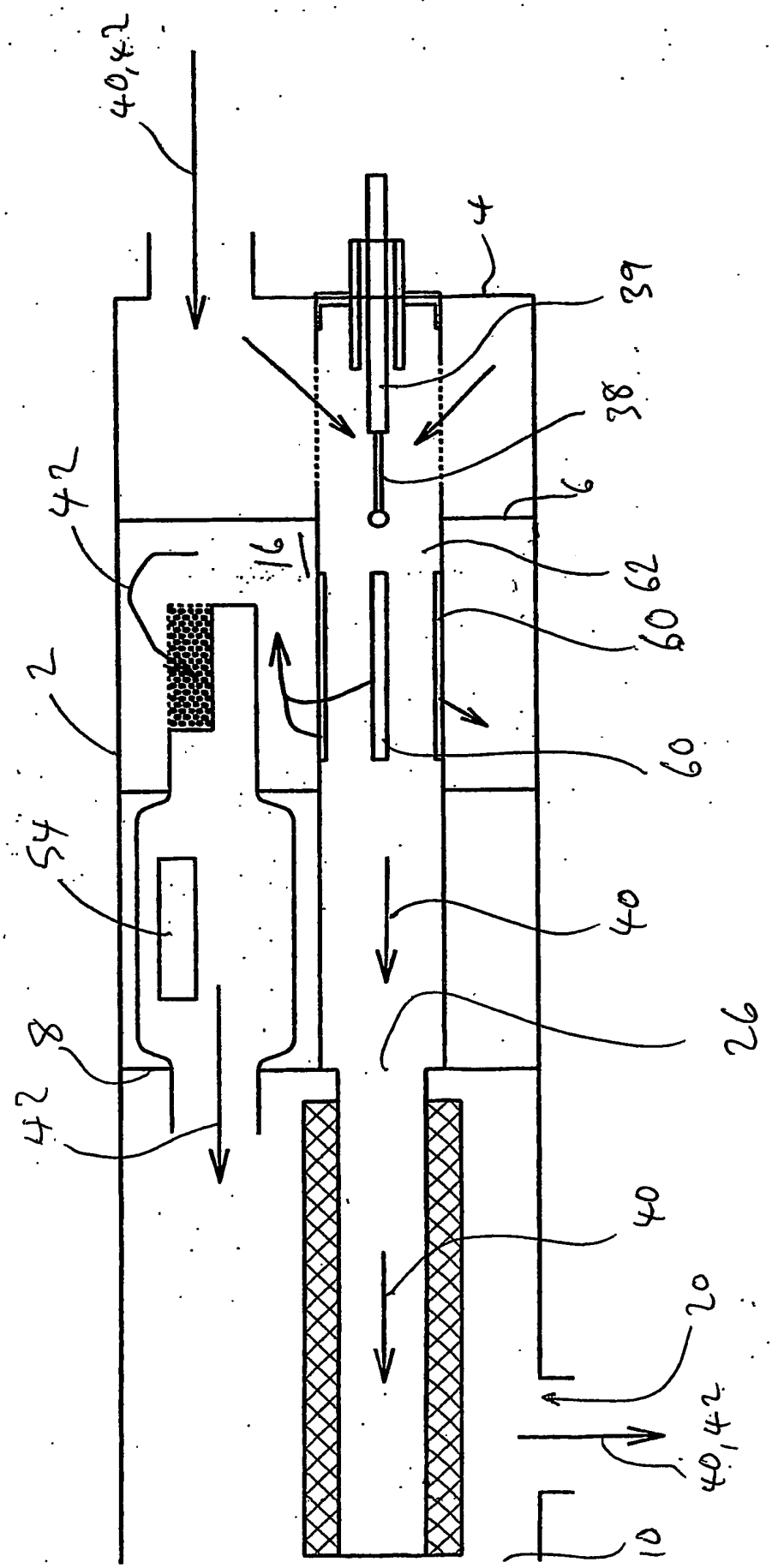
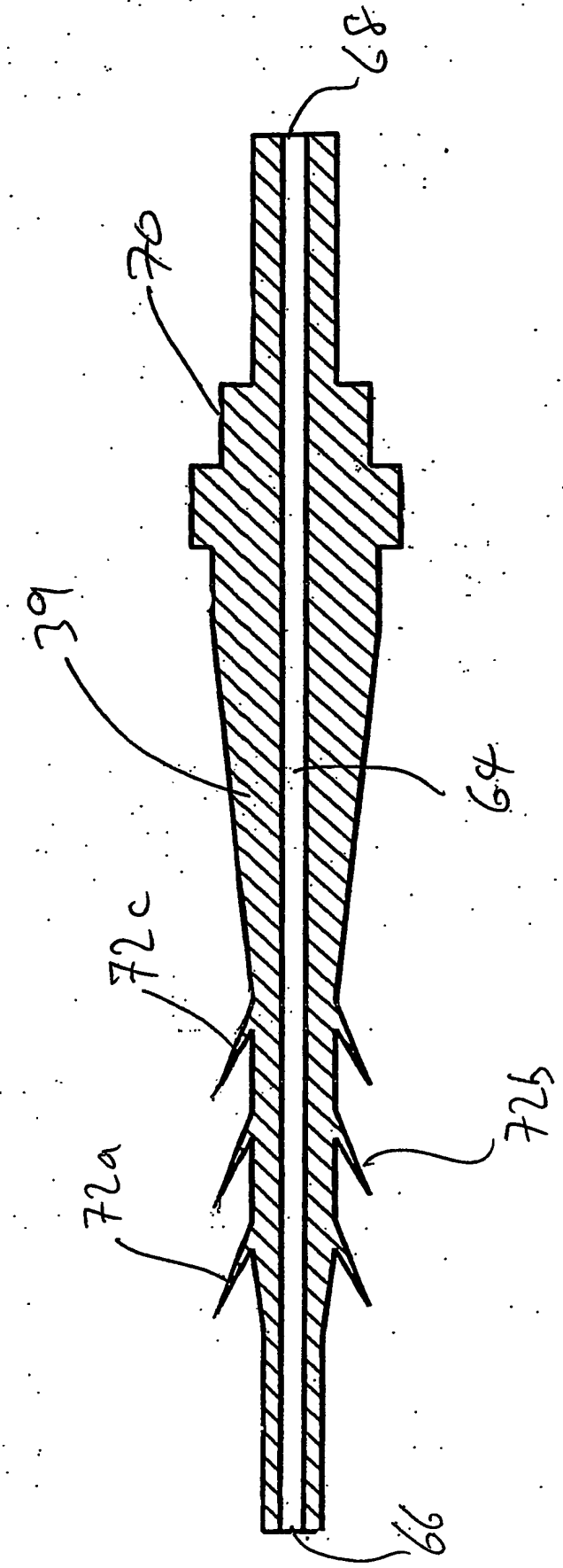


Fig 8



IMPROVEMENTS IN AND RELATING TO GAS FLOW ARRANGEMENTS

Field of the Invention

The present invention relates to gas flow arrangements and to pollutant removal devices incorporating such gas flow arrangements.

Background to the Invention

The present invention finds particular, but not exclusive, application in the field of the removal of pollutants from vehicle exhaust gas streams. In this application, often a filter is used to remove pollutants, especially particulate pollutants. However, as particulate material is built up in the filter, the porosity of the filter decreases thus increasing back pressure on the exhaust system which can reduce engine efficiency. Since environmental concerns are the primary reason for removing pollutants, such a decrease in efficiency, with a resultant increase in pollutants, defeats the object of many such proposed filtration devices.

It is an aim of preferred embodiments of the present invention to obviate or overcome at least one disadvantage of the prior art, whether referred to herein or otherwise.

Summary of the Invention

According to the present invention in a first aspect, there is provided a gas flow arrangement comprising a gas entrance and a gas exit, a first flow path from the gas entrance to the gas exit through a means for removing at

least one pollutant from a gas flow stream and second flow path from the gas entrance to the gas exit other than through the removing means.

Suitably, gas passing through the removing means intersects with the first gas flow.

Thus pressure differences can be minimised and undue back pressure is avoided. To the extent that gas is blocked from a first it can follow the second flow path avoiding the filter.

Suitably, the first flow path diverges from the second flow path upstream of the removing means.

Suitably, the first flow path and the second flow path intersect with each other downstream of the removing means. Thus the gas in one flow path is reintroduced into the gas of the other flow path.

Suitably, the first flow path diverges from the second flow path at a tube through which gas can pass. Suitably, the tube is a perforated tube.

The first and second flow paths may be in common for some of their respective passages through the arrangement, but they form discrete flow paths before intersecting downstream of the filter.

Suitably, the arrangement comprises a first chamber, a second chamber and a third chamber, whereby gas enters into a first chamber, passes into a second chamber at which the first flow path diverges from the second flow

path, and whereby gas can flow into the third chamber through two openings one of which comprises the removing means, and in which there is an exit for gas from the third chamber.

Suitably, the removing means comprises a filter.

Suitably, the filter comprises a regenerative filter. Suitably, the filter is electrically regenerative.

Thus, the arrangement provides a gas flow apparatus.

According to the present invention in a second aspect, there is provided a pollutant removal device comprising a gas flow arrangement according to the first aspect of the invention.

Suitably, the device comprises means for at least partially ionising gas flow. Suitably, the ionising means comprises an electrode for electrostatic precipitation. Suitably, the electrode is mounted in the second chamber. Suitably, the electrode is mounted in the first chamber.

Suitably, the apparatus comprises a tube through which the gas stream at least partly flows, whereby the tube is at least partly porous to the gas stream.

Suitably, the tube is at least partly about the charging means.

Suitably, the tube is perforated. Suitably, the tube comprises a plurality of holes therethrough. Suitably, the holes are evenly spaced. Suitably, the holes are

evenly sized. Suitably, the perforated region of the tube is substantially annular. Suitably, the perforated region of the tube extends for a substantial length thereof.

Suitably, the tube comprises at least one slot therethrough. Suitably, a plurality of slots is provided. Suitably, the slots are substantially evenly distributed about the tube. Suitably, the at least one slot runs longitudinally along the tube.

Suitably, a major portion of the tube is porous. Alternatively a minor portion of the tube is porous.

Suitably, the tube is circular in cross-section. Suitably, the tube comprises an inlet and an outlet.

Suitably, the cross-sectional area of the tube decreases along its length from the input to the output thereof.

Suitably, the electrode is mounted at one end thereof only.

Suitably, the tube is located in the first and second gas flow paths. The tube acts to split the gas flows and concentrate at least one pollutant in one flow path for subsequent removal.

Suitably, the apparatus comprises a first expansion tube in fluid communication with an apparatus gas inlet. Suitably, the diverting tube extends from the first expansion tube to a second expansion tube defined by the tube. Suitably, there is a third expansion tube about the diverting tube into which gas can flow through the

diverting tube. Suitably, a filter is located between (in respect of gas flow) the second and third expansion tubes.

Suitably, the device is arranged whereby at least one pollutant is biassed towards the first flow path (ie a substantial majority of an input pollutant flows through the first flow path, subject to being trapped by the filter).

Suitably, a catalytic converter is provided in the second flow path.

Suitably, the electrode projects from the first chamber in to the second chamber.

Suitably, the second flow path includes a catalytic converter.

Suitably, the device is for fitting to a vehicle exhaust. Suitably, the device is for fitting within the silencer of a vehicle exhaust.

Brief Description of the Drawings

The present invention will now be described, by way of example only, with reference to the drawings that follow; in which:

Figure 1 is a schematic perspective (partly cut away) illustration of a gas flow arrangement according to an embodiment of the present invention.

Figure 2 is a schematic perspective (partly cut away) illustration of the gas flow arrangement shown in Figure 1 from a reverse angle.

Figure 3 is a longitudinal cross-sectional view of the arrangement shown in Figures 1 and 2.

Figure 4 is an enlarged partly cut away and sectional drawing of the filter shown in Figures 1 and 2.

Figure 5 is a schematic partly cut away illustration of an embodiment of a particulate filtration device according to the present invention.

Figures 6 and 7 are schematic partly cut away illustrations of two further embodiments of a device according to the present invention.

Figure 8 is a schematic longitudinal cross-sectional view of an electrode mount.

Description of the Preferred Embodiment

Referring to Figures 1-3 of the drawings that follow, there is shown a gas flow arrangement within a circular cylindrical tubular body indicated by dashed line 2. The body 2 is defined internally by wall plates 4, 6, 8 and 10 respectively into a first chamber 12, a second chamber 14 and a third chamber 16. The body 2 is provided with a gas entry tube 18 and gas exit tube 20. Gas entry tube 18 extends from the exterior wall plate 4 to first chamber 12. That is, gas enters at the entrance of 18 and exits into first chamber 12. Gas exit tube 20 extends from the

exterior of wall plate 10 to third chamber 16. Additionally, there is provided a perforated tube 22 extending between first chamber 12 and third chamber 16, the perforations opening into second chamber 14. The tube 22 is highly perforated whereby in a given annulus there is more area taken up by holes than by solid. The preferred structure is substantially constant radially and longitudinally.

A filter 24 for removing pollutants from the gas stream is mounted in third chamber 16 about an opening 26 between third chamber 16 and second chamber 14.

The filter 24 is an electrically regenerative filter such as the filter identified as 3M part number SK-1739.

The filter 24 is shown in more detail in Figure 4 of the drawings that follow. The filter 24 comprises a tubular outer body 28 of a NEXTEL 312 filtration mounted on a porous metallic frame 30 which is connected to earth (which may be a floating earth) at one end 32. The other end 34 provides an electrical connection 36 (see also Figures 1 and 2) to a power supply 37 (Figure 5) to achieve heating and regeneration of the filter 24 as is known in the art.

An electrode 38 is mounted on wall plate 10 by a ceramic electrode mount 39 to project into the hollow interior of perforated tube 22 as shown in cross-section in relation to Figure 4 of the drawings that follow in which corresponding reference numerals are used.

In use, pollutant eg particulate carrying gas enters the arrangement at 18 and passes into first chamber 12 from which its only route is into perforated tube 22. In operation the electrode is highly charged to between 30kV-40kV negative polarity d.c. to ionise particulates in the gas stream forcing them through the perforated holes of the tube 22 in to second chamber 14 (under full load the potential may be about 10kV). Additionally, it is believed that the gas becomes at least partly ionised.

The perforated tube 22 opens into third chamber 16 allowing gas to pass through exit tube 20 to exhaust. Further, gas can flow from second chamber 14 to third chamber 14 through hole 26 through filter 24. Thus filter 24 can collect particulate material. The filter 24 is regenerative so that at intervals it is electrically regenerated. This need not be on a regular basis. However, if for any reason the filter 24 does not regenerate fully or a heavy loading occurs causing back pressure between filter 24 and second chamber 14, this is compensated for because gas can still flow to exit tube 20 through perforated tube 22 and third chamber 16. Thus build up of particulates (or other pollutants) in filter 24 will not cause undue back pressure on the engine providing an exhaust stream to the gas flow arrangement. As a result, the problem of back pressure encountered in relation to prior art filtration arrangements is overcome by embodiments of the present invention and there is provided a geometrically efficient and compact gas flow arrangement.

Referring to Figure 6 of the drawings that follow, there is shown another embodiment of a gas flow arrangement and

pollutant removal device according to the present invention. The arrangement and device is similar to that described in relation to Figure 5 (and similar reference numerals are used for corresponding integers), except that the first gas flow path 40 through filter 24 is generally straight on, ie the flow path does not diverge substantially from the path of the tube 22 to the filter 24 and the second gas flow path 42 follows the more tortuous route as shown.

To bias the particulate pollutants to follow first gas flow path 40 at Figure 6, instead of a highly perforated tube 22 (considered over the length at tube 22) a small area 50 of perforated tube 52 with a lower hole density is provided. The less perforated tube 52 is not annular, it just occupies a slot in the tube. As the effect of the corona discharge electrode 38 with the floating earth of the tube 52 is to draw particulates to the side (tube 52) walls where they tend to agglomerate, by providing less open area for the agglomerated particulate to pass through, it is less likely that particulates will follow the second flow path 42.

Another difference in the Figure 6 embodiment is the provision of a catalytic converter 54 in the second flow path 42 for the removal of hydrocarbons from the gas stream.

Figure 7 is a yet further embodiment of the present invention substantially similar to the embodiment of Figure 6, except that four equally spaced longitudinal slits 60 are provided over a substantial minority of the surface area of tube 62.

Referring to Figure 8 of the drawings that follow, the electrode mount 39 is shown in more detail. The electrode mount 39 is a one piece ceramic construction having a longitudinal hole 64 therethrough for the electrode 38 (not shown in Figure 8). The electrode projects from distal end 66 and is connected to a power source at end 68. The electrode mount 39 is held by a bracket (not shown) about shoulder 70. Protrusions 72a, 72b and 72c project from the exterior of electrode mount 39. The protrusions 72 are partly hollow, rebated conical shapes that provide a tortuous route from the electrode 38 projecting from distal end 66 to earth to reduce leakage.

It is noted that there may be a plurality of devices, a plurality of filters and/or a plurality of catalytic converters.

Instead of using direct current as described above, high frequency a.c can be used.

Thus embodiments of the present invention provide a first gas flow path 40 (Figure 5) from gas entrance 18 to gas exist 20 via first chamber 12, tube 22, third chamber 16 through filter 24 and second chamber 14 and a second gas flow path 42 (Figure 4) from gas entrance 18 to gas exit 20 via first chamber 12, tube 22 and second chamber 14 which is other than through the filter 24.

The reduced gas flow through filter 24 when compared with a corresponding device in which all of the input gas stream flows through filter 24 makes the electrical

regeneration of the filter more efficient because the thermal effect of the gas flow is correspondingly reduced.

Preferred embodiments of the present invention find particular benefit in the application of pollutant, especially particulate removal from exhaust gas streams, especially of internal combustion engines. For such engines the arrangement can be mounted within the vehicle silencer to avoid taking up unnecessary space. The device may be upstream or downstream of a catalytic converter.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extend to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.